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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
JUN KAMATANI ET AL.)
Application No.: 10/073,012)
Filed: February 12, 2002)
For: LUMINESCENCE DEVICE AND)
DISPLAY APPARATUS)
Examiner: M. Yamnitzky
Group Art Unit: 1774
September 27, 2005

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUBMISSION OF SWORN TRANSLATIONS

Sir:

Further to the Amendment filed on August 26, 2005 in the above-captioned application, Applicants hereby submit sworn English language translations of parent International Application No. PCT/JP01/10487 and of all three Japanese priority applications, Japanese Patent Application Nos. 364650/2000; 064205/2001; and 128928/2001, certified copies of which were filed on November 26, 2003.

By submitting these sworn translations, Applicants believe that they have antedated U.S. Patent Application Publication No. 2003/0072964 A1 (Kwong), and removed that publication as prior art against those claims in the present application that are supported by the disclosure of the mentioned priority documents.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

Respectfully submitted,



Jason M. Okun
Attorney for Applicants
Registration No. 48,512

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200

NY_MAIN 527098v1



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(CFE3320US)

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DECLARATION

I, Ryuichi YAMADA, a Japanese Patent Attorney registered No. 7898 having my Business Office at Hasegawa Bldg., 4F, 7-7 Toranomom 3-chome, Minato-ku, Tokyo, Japan, solemnly and sincerely declare:

That I have a thorough knowledge of Japanese and English languages; and

That the attached pages contain a correct translation into English of the specification of the following Japanese Application:

<u>APPLICATION</u> <u>NUMBER</u>	<u>DATE OF</u> <u>APPLICATION</u>
364650/2000(Pat.)	30/NOV/2000

Applicant(s)
CANON KABUSHIKI KAISHA

Signed this 20th day of September, 2005.

Ryuichi YAMADA

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the
following application as filed with this Office.

<u>APPLICATION NUMBER</u>	<u>DATE OF APPLICATION</u>
364650/2000(Pat.)	30/NOV/2000

Applicant(s)
CANON KABUSHIKI KAISHA

11/NOV/2003

Director-General,
Patent Office : YASUO IMAI (Seal)

Certificate No. 3092893/2003

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<DOCUMENT> PATENT APPLICATION

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<FILING DATE> 30/NOV/2000

<DIRECTED TO> The Director General of the Patent Office

<INTERNATIONAL CLASSIFICATION> H05B 33/00

<TITLE OF THE INVENTION> LUMINESCENCE DEVICE AND
DISPLAY APPARATUS

<NUMBER OF CLAIMS> 5

<INVENTOR(S)>

<Address> c/o CANON KABUSHIKI KAISHA
3-30-2 Shimomaruko, Ohta-ku, Tokyo

<Name> Jun KAMATANI

<Address> Ditto

<Name> Takao TAKIGUCHI

<Address> Ditto

<Name> Shinjiro OKADA

<Address> Ditto

<Name> Akira TSUBOYAMA

<Address> Ditto

<Name> Takashi MORIYAMA

<Address> Ditto

<Name> Koji NOGUCHI

<Address> Ditto

<Name> Manabu FURUGORI

<APPLICANT>

<IDENTIFICATION NO.> 000001007

<NAME> CANON KABUSHIKI KAISHA

<ATTORNEY>
<IDENTIFICATION NO.> 100096828
<PATENT ATTORNEY>
<NAME> Keisuke WATANABE
<TEL> 03-3501-2138

<DESIGNATED ATTORNEY>
<IDENTIFICATION NO.> 100059410
<PATENT ATTORNEY>
<NAME> Yoshio TOYODA
<TEL> 03-3501-2138

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<ARTICLES PRESENTED>
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<ARTICLE> Drawing(s) 1
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<GENERAL POWER NO.> 9703710

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[Document]

Specification

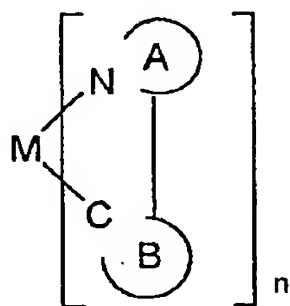
[Title of the Invention]

Luminescence Device and Display Apparatus

[Claims]

1. A luminescence device comprising a single or plurality of organic thin layers between a pair of oppositely disposed electrodes comprising a cathode and anode; at least one of layers is a luminescence layer; and wherein a luminescence molecule having an optional substituent, which is represented by formula (1) below, is used at a concentration which is larger than a concentration exhibiting a maximum luminescence efficiency in the case that the luminescence molecule having the same structure and not having the optional substituent:

<KA-1>



(1)

wherein M is a metal atom or Ir, Rh or Pd; n is 2 or 3; N and C are independently a nitrogen atom and a carbon atom and bonded to the metal atom M; A and B

are each cyclic group having a nitrogen atom and carbon atom having an optional substituent; the cyclic groups A and B are bonded to each other via a covalent bond; {(the optional substituent of the cyclic groups is selected from a halogen atom, a nitro group, a trialkylsilyl group (of which the alkyl groups are independently a linear or branched alkyl group having 1 to 8 carbon atoms), a linear or branched alkyl group having 1 to 20 carbon atoms of (which the alkyl group can include one or non-neighboring two or more methylene groups that can be replaced with -O-, -S-, -CO-, -CO-O-, -O-CO-, -CH=CH- or -C=C-, and the alkyl group can include two or more hydrogen atoms that can be optionally replaced with a fluorine atom)}; and the sum of a nitrogen atom and a sulfur atom or a hydrogen atom of the cyclic groups A and B is not less than 1; the compounds contains at least one of a fluorine atom, polyfluorinated alkyl, a single group structure, a cyclic structure having two or more cyclic groups, or at least alkyl group.

2. A luminescence device according to Claim 1, wherein a luminescence molecule having an optional substituent, which is represented by said formula (1), used at a concentration which is larger than a concentration which exhibits a maximum luminance in the case that the luminescence molecule having the

same structure and not having the optional substituent is used under the same voltage application.

3. A luminescence device according to Claim 1 or 2, wherein a luminescence molecule having an optional substituent, which is represented by said formula (1), used at a concentration which is larger than a concentration which exhibits a maximum current density in the case that the luminescence molecule having the same structure and not having the optional substituent is used under the same voltage application.

4. A luminescence device according to any one of Claims 3 to 5, wherein the organic layer including said metal coordination compound comprises an electric-field luminescence device between a pair of oppositely disposed electrodes comprising a transparent electrode (anode) and a metal electrode (cathode) which are supplied with a voltage to cause luminescence.

5. A display apparatus, comprising a luminescence device as defined in any one of Claims 1 to 4, as a display device.

[Detailed Description of the Invention]

[Field]

The present invention relates to a luminescence device using an organic compound. More particularly, the invention relates to a luminescence device less causing the concentration extinction (deactivation) while having a high luminescence efficiency even when a luminescence material of a metal coordination compound is used at a high concentration as a luminescence layer.

[Prior Art]

An extensive study for an organic EL device formation as a luminescence device of a high-speed responsiveness and a high efficiency, has been conducted. The basic structure of the organic EL device is illustrated in Figures 1A and 1B (for example, Macromol. Symp. 125, 1 - 48 (1977)).

As described in Figure 1, an organic EL device generally comprises, on a transparent substrate 15, a transparent electrode 14, a plurality of organic film layers and a metal electrode 11 formed so as to cover the organic layers.

Referring to Figure 1A, the organic layer comprises a luminescence layer 12 and a hole-transporting layer 13. The transparent electrode 14 may comprises ITO or the like, having a large work function so as to facilitate hole injection from the transparent electrode 14 to the hole-transporting

layer 13. The metal electrode 11 comprises a metal material having a small work function, such as aluminum, magnesium or alloys of these elements, so as to facilitate electron injection into the organic luminescence device. The film having the thickness of 50 to 200 nm is used for the electrodes.

In the luminescence layer 12, aluminum quinolinol complex (inclusive of Alq3 shown in KA-2 as a representative example) having an electron-transporting characteristic and a luminescence characteristic, are used for example. In a hole-transporting layer, a material having an electron-donative property, such as a triphenyldiamine derivative (inclusive of α -NPD shown in KA-2 as a representative example), is used for example.

A device organized above exhibits a current-rectifying characteristic, and when an electric field is applied between the metal electrode 11 as a cathode and the transparent electrode 14 as an anode, electrons are injected from the metal electrode 11 into the luminescence layer 12, and holes are injected from the transparent electrode 15.

The injected holes and electrons are recombined in the luminescence layer 12 to form excitons, which cause luminescence. In this instance, the hole-transporting layer 13 functions as an electron-blocking layer to increase the recombination

efficiency at the boundary between the luminescence layer layer 12 and the hole-transporting layer 13, thereby providing an enhanced luminescence efficiency.

Further, in the structure of Figure 1(b), an electron-transporting layer 16 is disposed between the metal electrode 11 and the luminescence layer 12 in Figure 1(a). As a result, the luminescence function is separated from the functions of electron transportation and hole transportation to provide a structure exhibiting more effective carrier blocking, thus increasing the luminescence efficiency. The electron-transporting layer 16, may comprise, e.g., an oxadiazole derivative.

In ordinary organic EL devices, fluorescence caused during a transition of luminescent center molecule from a singlet excited state to a ground state is used as luminescence. On the other hand, not the above fluorescence (luminescence) via singlet exciton, phosphorescence (luminescence) via triplet exciton has been studied for use in organic EL devices as described in, e.g., "Improved energy transfer in electrophosphorescent device" (D.F. O'drien et al., Applied Physics Letters. Vol. 74, No. 3, pp. 442 - 444 (1999)) and "Very high-efficiency green organic light-emitting devices based on electrophosphorescence" (M.A. Baldo et al., Applied Physics Letters, Vol. 75, No. 1, pp. 4 - 6 (1999)).

The EL devices shown in these documents may generally have a sectional structure shown in Figure 1C. Referring to Figure 1C, four organic layers including a hole transfer layer 13, a luminescence layer 12, and exciton diffusion-prevention layer 17, and an electron transport layer 16 are successively formed in this order on the transparent electrode (anode) 14. The materials used therein include carrier-transporting materials and phosphorescent materials which is represented in KA-2, of which the names and structures are shown below together with their abbreviations.

Alq3: aluminum-quinolinol complex,

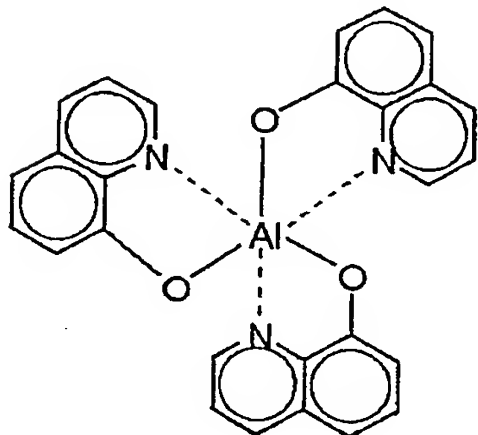
α -NPD: N4,N4'-di-naphthalene-1-yl-N4,N4'-diphenyl-biphenyl-4,4'-diamine,

CBP: 4,4'-N,N'-dicarbazole-biphenyl,

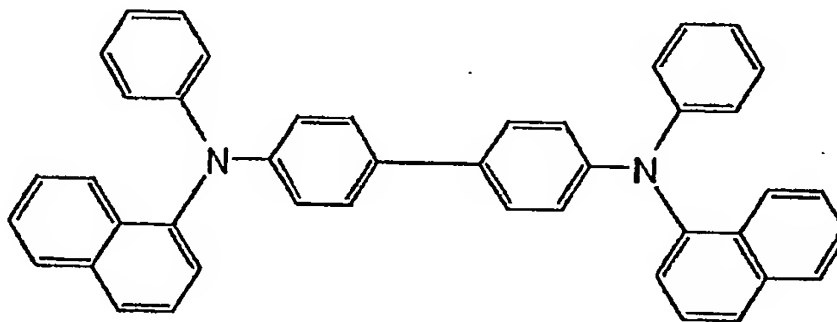
BCP: 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline,

PtOEP: platinum-octaethyl porphine complex,
and

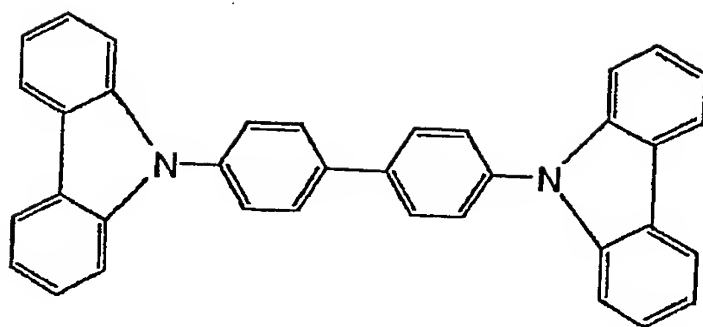
Ir(ppy)₃: iridium-phenylpyridine complex.



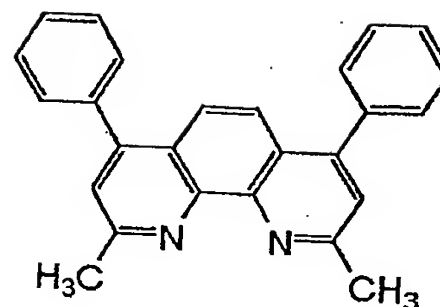
Alq3



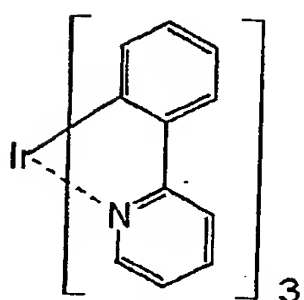
α -NPD



CBP



BCP



Ir(ppy)₃

The above-mentioned Articles 1 and 2 both have reported structures, as exhibiting a high efficiency, including a hole-transporting layer 13 comprising α -NPD, an electron-transporting layer 16 comprising Alq3, an exciton diffusion-preventing layer 17 comprising BCP, and a luminescence layer 12 comprising CBP as a host and ca. 6 % of PtOEP or Ir(ppy)₃ as a phosphorescent material dispersed in mixture therein.

Such a phosphorescent material is particularly noted at present because it is expected to provide a high luminescence efficiency in principle for the following reasons. More specifically,

excitons formed by carrier recombination comprise singlet excitons and triplet excitons in a probability ratio of 1:3. Conventional organic EL devices have utilized fluorescence caused by the transition of a singlet exciton to a ground state, of which the luminescence efficiency is limited to at most 25 %. On the other hand, if phosphorescence generated from triplet excitons is utilized, an efficiency of at least three times is expected, and even an efficiency of 100 %, i.e., four times, can be expected in principle, if a transition owing to intersystem crossing from a singlet state having a higher energy to a triplet state is taken into account.

The use of phosphorescence based on transition from the triplet excited state has also been proposed in, e.g., Japanese Laid-Open Patent Application No. HEI-11-329739 (organic EL device and manufacturing method for organic EL device), Japanese Laid-Open Patent Application No. HEI-11-256148 (luminescence material and organic EL device using the luminescence material) and HEI-8-319482 (organic electroluminescence device).

[Problems to be Solved]

However, the above-mentioned organic EL devices utilizing phosphorescence have accompanied with a problem of the occurrence of concentration extinction or concentration deactivation of the

luminescence material. The reason for occurrence of concentration extinction has been clarified as yet but may be attributable to such a phenomenon that the life of triplet exciton is generally longer than that of single exciton by at least three digits, so that molecule is placed in a higher-energy state for a long period to cause reaction with ambient substance, formation of exciplex or excimer, radiation deactivation or the like.

The luminescence layer comprising CPB as a host material and 6 % in the concentration of Ir(ppy)_3 as a guest phosphorescence material dispersed in mixture in the CPB exhibits a highest luminescence efficiency. When the Ir(ppy)_3 as a guest phosphorescence material have the concentration of not less than 6 %, the luminescence efficiency of the luminescence device is lower. The luminescence efficiency exhibits half at 12 % in the concentration of Ir(ppy)_3 , and it exhibits 1/10 at 100 % in the concentration of Ir(ppy)_3 .

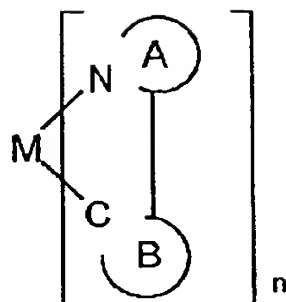
In the phosphorescence luminescence device is used, it is expected to provide the high luminescence efficiency, however, the concentration extinction occurs. Therefore, when the luminescence device is manufactured, it is necessary to dope the Ir(ppy)_3 into CBP at a concentration of not more than prescribed level.

Accordingly, it is a principal object of the present invention to provide a luminescence device wherein the optional substituent is introduced into a luminescence material of a metal coordination compound, whereby it is possible to provide a luminescence device less causing a concentration extinction (deactivation) while having a high luminescence efficiency even when a luminescence material as a host material with a phosphorescent material is dispersed into the host material at a higher concentration, and a display device.

[Means for Solving the Problems]

More specifically, in accordance with a principal aspect of the present invention, there is provided a luminescence device comprising a single or plurality of organic thin layers between a pair of oppositely disposed electrodes comprising a cathode and an anode; at least one of layers is a luminescence layer; and wherein a luminescence molecule having an optional substituent, which is represented by formula (1) below, is used at a concentration which is larger than a concentration exhibiting a maximum luminescence efficiency in the case that the luminescence molecule having the same structure and not having the optional substituent:

<KA-3>



(1)

wherein M is a metal atom or Ir, Rh or Pd; n is 2 or 3; N and C are independently a nitrogen atom and a carbon atom and bonded to the metal atom M; A and B are each cyclic group having a nitrogen atom and carbon atom having an optional substituent; the cyclic groups A and B are bonded to each other via a covalent bond; {(the optional substituent of the cyclic groups is selected from a halogen atom, a nitro group, a trialkylsilyl group (of which the alkyl groups are independently a linear or branched alkyl group having 1 to 8 carbon atoms), a linear or branched alkyl group having 1 to 20 carbon atoms of (which the alkyl group can include one or non-neighboring two or more methylene groups that can be replaced with -O-, -S-, -CO-, -CO-O-, -O-CO-, -CH=CH- or -C≡C-, and the alkyl group can include a hydrogen atoms that can be optionally replaced with a fluorine atom)}; and the sum of a nitrogen atom and a sulfur atom or a hydrogen atom of the cyclic groups A and B is not less than 1; the compounds contains at least one of a fluorine atom, polyfluorinated alkyl, a single group structure,

a cyclic structure having two or more cyclic groups, or at least alkyl group.

A luminescence device according to the present invention may be preferable that a luminescence molecule having an optional substituent, which is represented by the formula (1), used at a concentration which is larger than a concentration which exhibits a maximum luminance in the case that the luminescence molecule having the same structure and not having the optional substituent is used under the same voltage application.

A luminescence device according to the present invention may be preferable that a luminescence molecule having an optional substituent, which is represented by the formula (1), used at a concentration which is larger than a concentration which exhibits a maximum current density in the case that the luminescence molecule having the same structure and not having the optional substituent is used under the same voltage application.

The luminescence device may preferably that the organic layer comprising the metal coordination compound comprises an electric-field luminescence device between a pair of oppositely disposed electrodes comprising a transparent electrode (anode) and a metal electrode (cathode) which are supplied with a voltage to cause luminescence.

In accordance with a further aspect of the present invention, there is provided a display apparatus, comprising a luminescence device described above, as a display device.

[Description of the Preferred Embodiments]

In the case where the luminescence layer comprises a host material having a carrier-transporting function and a phosphorescent guest material, a process of phosphorescence via triplet excitons may include unit processes as follows:

1. transportation of electrons and holes within a luminescence layer,
2. formation of host excitons,
3. excitation energy transfer between host molecules,
4. excitation energy transfer from the host to the guest,
5. formation of guest triplet excitons, and
6. transition of the guest triplet excitons to the ground state and phosphorescence.

Desirable energy transfer in each unit process and luminescence are caused in competition with various energy deactivation processes.

Needless to say, a luminescence efficiency of an EL device is increased by increasing the luminescence quantum yield of a luminescence center material. In addition thereto, the efficiency energy

transfer between host material molecules and/or between host material molecule and guest material molecule is also an important factor. Further, the above-mentioned occurrence of the concentration extinction may presumably relate to suppress of the excited state with the radiationless transition due to progress of polymer formation reaction between the luminescence central material molecules or those and their surrounding material molecules.

As a result of various studies of inventors, it has been found that an EL device using the metal coordination compound of the formula (1) as a principal luminescence material causes high luminescence efficiency, suppresses the reaction between the molecules, and shows little concentration extinction even if a luminescence material as a host material with a phosphorescent material is dispersed into the host material at a higher concentration relative the conventional concentration.

The metal coordination compound used in the present invention emits phosphorescence, and its lowest excited state is believed to be an MLCT* (metal-to-ligand charge transfer) excited state in a triplet state, and phosphorescence is caused at the time of transition from such a state to the ground state.

The luminescence material exhibited high

phosphorescence quantum yields of 0.15 to 0.9 and short phosphorescence lives of 1 to 30 μ sec. A short phosphorescence life becomes a condition for causing little energy deactivation and exhibiting an enhanced luminescence efficiency. More specifically, if the phosphorescence life is long, the number of triplet state molecules maintained for luminescence is increased, and the deactivation process is liable to occur, thus resulting in a lower luminescence efficiency particularly at the time of a high-current density. The material of the present invention is suitable as a luminescence material for an EL device having a high phosphorescence quantum yield and a short phosphorescence life. Further, the short phosphorescence lives is realized, and the time remained the molecules in the triplet state is short, so that the time remained the molecules in the higher energy state is short, so that the concentration extinction (deactivation) is reduced.

In an actual current conduction test, the luminescence material of the present invention showed a high stability.

When two or more fluorine atoms combined in two cyclic groups is contained in the ligand of the present invention, the energy gap can be changed, that is, short or long wavelength luminescence can be caused. It is understood that the energy of HOMO

(Highest Occupied Molecular Orbital)/LUMO (Lowest Unoccupied Molecular Orbital) in the ligand is changed by the fluorine atom when HOMO/LUMO of the orbital in the metal is different from the HOMO/LUMO of the orbital in the ligand for convenience' sake, that the energy gap between the HOMO of metal and the LUMO of ligand is changed, so that low wavelength luminescence, and high wavelength luminescence can be emitted in the MLCT* (metal-to-ligand charge transfer) as a low-energy excited state. As a result, the metal coordination metal of the present invention is a luminescence material suitable to emit the high wavelength (red) luminescence and the low wavelength (blue) and have the high luminescence efficiency. Further, when the metal coordination compound is used as the device, it is possible to reduce the energy deactivation between the molecules in the excited state, to improve the uniformity in film, to improve the electrical property, and to improve the stability of device, since the reaction between the molecules can be controlled.

In the luminescence material of the present invention, when the two or more fluorine atoms, polyfluorine atoms and alkyl groups are contained in the ligand as the substituent, the substituent projects from the ligand, and the reaction between the substituent and the luminescence device is suppressed,

thus less causing the concentration extinction.

By introducing the structure that a single cyclic structure or two or more cyclic structures are connected to each other in such as to cut conjugate with ligand in the end of alkyl substituent, the group functions as transportation of the electron, hole to the luminescence molecule, and suppression of the bidentate ligand between the luminescence materials. Further, the difference between HOMO level and LUMO level in the compound having the end connective group of alkyl substituent, is larger than the difference between HOMO level and LUMO level in the complex compound not having the alkyl substituent, exhibits the promotion of the transfer to the carrier such as an hole, electron or complex compound of excited energy.

As a result, the conventional luminescence material did not exhibit the high luminescence efficiency and high stability of device at the short wavelength and long wavelength. However, the luminescence material of the present invention can be realized.

In the phosphorescent material, the luminescence property depends on the ambient molecular structure. In the fluorescence device, the basic property of the luminescence material is investigated by the photo-luminescence. However, the

phosphorescent luminescence depends on the strength of polarity of the host molecular surrounded the phosphorescent material, temperature, solid/liquid or the like, so that it is liability that the results for the photoluminescence is not reflected in the luminescence property of the EL device. Generally, the EL property except for the part of the property cannot be estimated on the results for photoluminescence.

As understood of Examples which is described below, it was clarified that the compound having the substituent of the present invention has the high luminescence property at a high concentration, compound to the compound having no substituent.

The luminescence device may preferably that the organic layer including the metal coordination compound comprises an electric-field luminescence device between a pair of oppositely disposed electrodes comprising a transparent electrode (anode) and a metal electrode (cathode) which are supplied with a voltage to cause luminescence.

The luminescence device having a high efficiency of the present invention is applicable to the product which requires for energy saving and high luminosity. As an example of application, the light source of a display apparatus and an illumination apparatus or printer, the back light of a liquid

crystal display apparatus or the like, can be considered. As for a display apparatus, energy saving, and high visibility and a light flat panel display are provided. As for a light source of a printer, the laser light source of the laser beam printer used widely can be transposed to the luminescence device. The device which can carry out an address independently is disposed on an array, and image formation is performed by performing a desired exposure process to the photosensitive drum. By using the device of the present invention, the volume of the apparatus can be decreased sufficiently. The energy saving effect according to the present invention is expected regarding the illumination apparatus and back light.

Some specific structural examples of metal coordination compounds used in the present invention are shown in Table 1 to Table 11 appearing hereinafter, which are however only representative examples and are not exhaustive. Ph to PQ3 used for Table 1 to Table 11 represented partial structures (KA-4) shown below.

<KA-4>

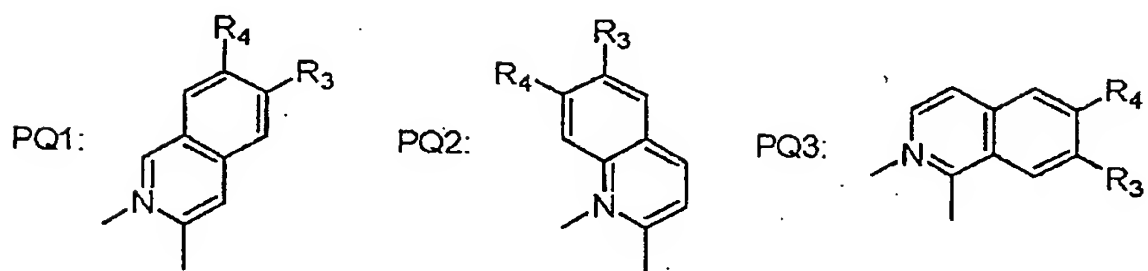
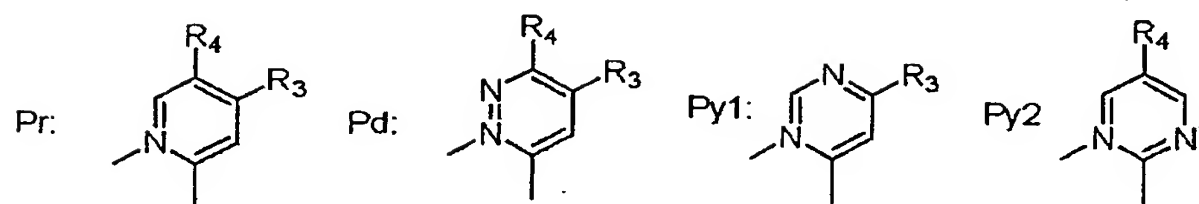
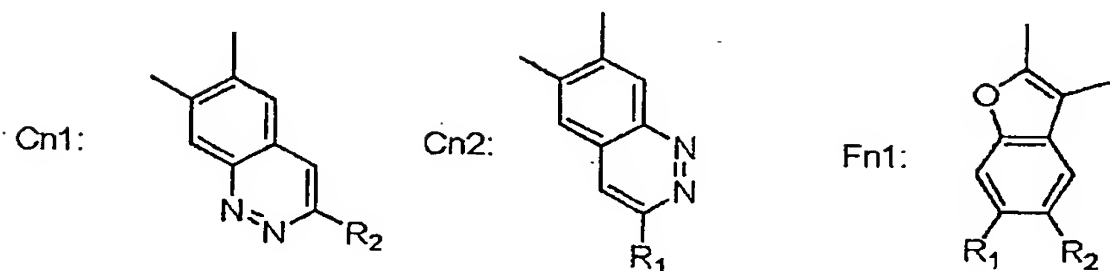
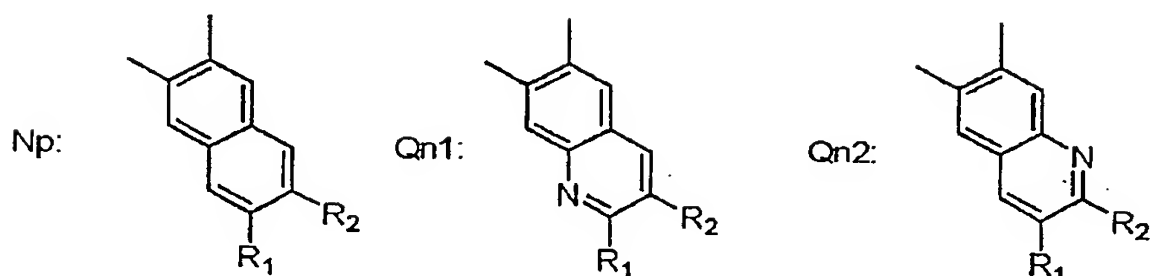
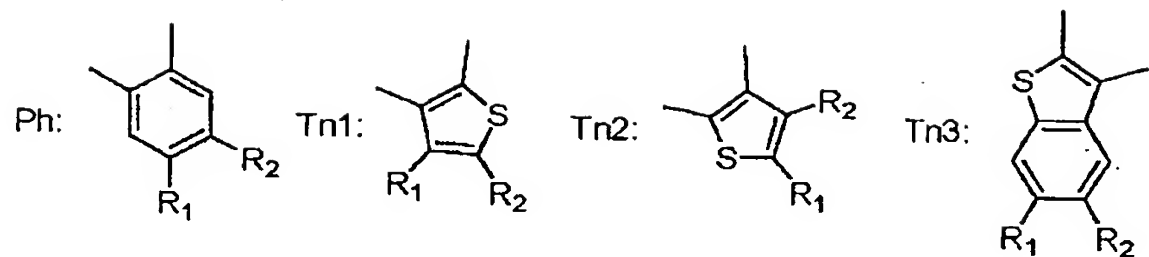


Table 1


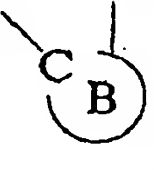
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5	Ir	3	Pr	Ph	F	H	F	H
6	Ir	3	Pr	Ph	H	F	F	F
7	Ir	3	Pr	Ph	H	F	F	H
8	Ir	3	Pr	Ph	H	F	H	F
9	Ir	3	Pr	Ph	F	F	F	F
10	Ir	3	Pr	Ph	CF ₃	H	H	H
11	Ir	3	Pr	Ph	H	CF ₃	H	H
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31	Ir	3	Pr	Ph	H	(CH ₃) ₂ CH ₃	H	H
32	Ir	3	Pr	Ph	(CH ₃) ₂ CH ₃	H	H	H
33	Ir	3	Pr	Ph	H	H	(CH ₃) ₂ CH ₃	H
34	Ir	3	Pr	Ph	H	H	H	(CH ₃) ₂ CH ₃

Table 2


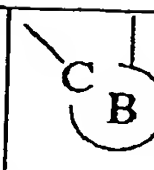
No	H	n			R1	R2	R3	R4
35	Ir	3	Pr	Tn1	F	H	H	H
36	Ir	3	Pr	Tn1	H	F	H	H
37	Ir	3	Pr	Tn1	H	H	F	H
38	Ir	3	Pr	Tn1	F	F	H	H
39	Ir	3	Pr	Tn1	F	H	F	H
40	Ir	3	Pr	Tn1	H	F	F	F
41	Ir	3	Pr	Tn1	H	F	F	H
42	Ir	3	Pr	Tn1	H	F	H	F
43	Ir	3	Pr	Tn1	F	F	F	F
44	Ir	3	Pr	Tn1	CF ₃	H	H	H
45	Ir	3	Pr	Tn1	H	CF ₃	H	H
46	Ir	3	Pr	Tn1	H	H	CF ₃	H
47	Ir	3	Pr	Tn1	H	H	H	CF ₃
48	Ir	3	Pr	Tn1	F	CF ₃	H	CF ₃
49	Ir	3	Pr	Tn1	CF ₃	H	CF ₃	H
50	Ir	3	Pr	Tn1	CF ₃	H	H	CF ₃
51	Ir	3	Pr	Tn1	H	F	CF ₃	H
52	Ir	3	Pr	Tn1	H	CF ₃	H	CF ₃
53	Ir	3	Pr	Tn1	H	H	CF ₃	F
54	Ir	3	Pr	Tn1	H	H	(CF ₃) ₂ CF ₃	H
55	Ir	3	Pr	Tn1	H	H	H	(CF ₃) ₂ CF ₃
56	Ir	3	Pr	Tn1	(CF ₃) ₂ CF ₃	H	H	H
57	Ir	3	Pr	Tn1	H	(CF ₃) ₂ CF ₃	H	H
58	Ir	3	Pr	Tn1	(CF ₃) ₂ CF ₃	H	F	H
59	Ir	3	Pr	Tn1	H	(CF ₃) ₂ CF ₃	H	F
60	Ir	3	Pr	Tn1	H	H	(CF ₃) ₂ CF ₃	H
61	Ir	3	Pr	Tn1	H	H	H	(CF ₃) ₂ CF ₃
62	Ir	3	Pr	Tn1	(CH ₃) ₂ CH ₃	H	H	(CH ₃) ₂ CH ₃
63	Ir	3	Pr	Tn1	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃	H
64	Ir	3	Pr	Tn1	H	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃
65	Ir	3	Pr	Tn1	H	(CH ₃) ₂ CH ₃	(CH ₃) ₂ CH ₃	H
66	Ir	3	Pr	Tn1	H	(CH ₃) ₂ CH ₃	H	H
67	Ir	3	Pr	Tn1	(CH ₃) ₂ CH ₃	H	H	H
68	Ir	3	Pr	Tn1	H	H	(CH ₃) ₂ CH ₃	H
69	Ir	3	Pr	Tn1	H	H	H	(CH ₃) ₂ CH ₃

Table 3


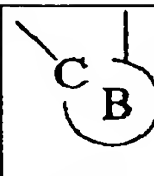
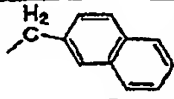
No	M	n			R1	R2	R3	R4
70	Ir	3	Pr	Tn2	F	H	H	H
71	Ir	3	Pr	Tn2	H	F	H	H
72	Ir	3	Pr	Tn2	H	H	F	H
73	Ir	3	Pr	Tn2	F	F	H	H
74	Ir	3	Pr	Tn2	F	H	F	H
75	Ir	3	Pr	Tn2	H	F	F	F
76	Ir	3	Pr	Tn2	H	F	F	H
77	Ir	3	Pr	Tn2	H	F	H	F
78	Ir	3	Pr	Tn2	F	F	F	F
79	Ir	3	Pr	Tn2	CF ₃	H	H	H
80	Ir	3	Pr	Tn2	H	CF ₃	H	H
81	Ir	3	Pr	Tn2	H	H	CF ₃	H
82	Ir	3	Pr	Tn2	H	H	H	CF ₃
83	Ir	3	Pr	Tn2	F	CF ₃	H	H
84	Ir	3	Pr	Tn2	CF ₃	H	CF ₃	H
85	Ir	3	Pr	Tn2	CF ₃	H	H	CF ₃
86	Ir	3	Pr	Tn2	H	F	CF ₃	H
87	Ir	3	Pr	Tn2	H	CF ₃	H	CF ₃
88	Ir	3	Pr	Tn2	H	H	CF ₃	F
89	Ir	3	Pr	Tn2	H	H	(CF ₃) ₂ CF ₃	H
90	Ir	3	Pr	Tn2	H	H	H	(CF ₃) ₂ CF ₃
91	Ir	3	Pr	Tn2	(CF ₃) ₂ CF ₃	H	H	H
92	Ir	3	Pr	Tn2	H	(CF ₃) ₂ CF ₃	H	H
93	Ir	3	Pr	Tn2	(CF ₃) ₂ CF ₃	H	F	H
94	Ir	3	Pr	Tn2	H	(CF ₃) ₂ CF ₃	H	F
95	Ir	3	Pr	Tn2	H	H	(CF ₃) ₂ CF ₃	H
96	Ir	3	Pr	Tn2	H	H	H	(CF ₃) ₂ CF ₃
97	Ir	3	Pr	Tn2	(CH ₃) ₂ CH ₃	H	H	(CH ₃) ₂ CH ₃
98	Ir	3	Pr	Tn2	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃	H
99	Ir	3	Pr	Tn2	H	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃
100	Ir	3	Pr	Tn2	H	(CH ₃) ₂ CH ₃	(CH ₃) ₂ CH ₃	H
101	Ir	3	Pr	Tn2	H	(CH ₃) ₂ CH ₃	H	H
102	Ir	3	Pr	Tn2	(CH ₃) ₂ CH ₃	H	H	H
103	Ir	3	Pr	Tn2	H	H	(CH ₃) ₂ CH ₃	H
104	Ir	3	Pr	Tn2	H	H	H	

Table 4


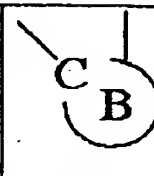
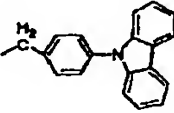
No	M	n			R1	R2	R3	R4
105	Ir	3	Pr	Tn3	F	H	H	H
106	Ir	3	Pr	Tn3	H	F	H	H
107	Ir	3	Pr	Tn3	H	H	F	H
108	Ir	3	Pr	Tn3	F	F	H	H
109	Ir	3	Pr	Tn3	F	H	F	H
110	Ir	3	Pr	Tn3	H	F	F	F
111	Ir	3	Pr	Tn3	H	F	F	H
112	Ir	3	Pr	Tn3	H	F	H	F
113	Ir	3	Pr	Tn3	H	H	F	F
114	Ir	3	Pr	Tn3	F	F	H	H
115	Ir	3	Pr	Tn3	F	F	F	F
116	Ir	3	Pr	Tn3	CF ₃	H	H	H
117	Ir	3	Pr	Tn3	H	CF ₃	H	H
118	Ir	3	Pr	Tn3	H	H	CF ₃	H
119	Ir	3	Pr	Tn3	H	H	H	CF ₃
120	Ir	3	Pr	Tn3	F	CF ₃	H	H
121	Ir	3	Pr	Tn3	CF ₃	H	CF ₃	H
122	Ir	3	Pr	Tn3	CF ₃	H	H	CF ₃
123	Ir	3	Pr	Tn3	H	F	CF ₃	H
124	Ir	3	Pr	Tn3	H	CF ₃	H	CF ₃
125	Ir	3	Pr	Tn3	H	H	CF ₃	CF ₃
126	Ir	3	Pr	Tn3	CF ₃	CF ₃	H	H
127	Ir	3	Pr	Tn3	H	CF ₃	CF ₃	H
128	Ir	3	Pr	Tn3	CF ₃	H	F	H
129	Ir	3	Pr	Tn3	F	H	CF ₃	H
130	Ir	3	Pr	Tn3	H	H	CF ₃	F
131	Ir	3	Pr	Tn3	H	H	(CF ₃) ₂ CF ₃	H
132	Ir	3	Pr	Tn3	H	H	H	(CF ₃) ₂ CF ₃
133	Ir	3	Pr	Tn3	(CF ₃) ₂ CF ₃	H	H	H
134	Ir	3	Pr	Tn3	H	(CF ₃) ₂ CF ₃	H	H
135	Ir	3	Pr	Tn3	(CF ₃) ₂ CF ₃	H	F	H
136	Ir	3	Pr	Tn3	H	(CF ₃) ₂ CF ₃	H	F
137	Ir	3	Pr	Tn3	H	H	(CF ₃) ₂ CF ₃	H
138	Ir	3	Pr	Tn3	H	H	H	

Table 5


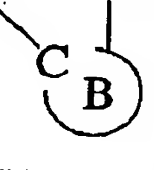
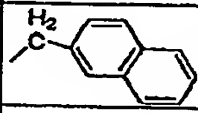
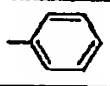
No	M	n			R1	R2	R3	R4
139	Ir	3	Pr	Tn3	(CH ₂) ₄ CH ₃	H	H	(CH ₂) ₄ CH ₃
140	Ir	3	Pr	Tn3	(CH ₂) ₄ CH ₃	H	(CH ₂) ₄ CH ₃	H
141	Ir	3	Pr	Tn3	H	(CH ₂) ₄ CH ₃	H	(CH ₂) ₄ CH ₃
142	Ir	3	Pr	Tn3	H	(CH ₂) ₄ CH ₃	(CH ₂) ₄ CH ₃	H
143	Ir	3	Pr	Tn3	H	(CH ₂) ₄ CH ₃	H	H
144	Ir	3	Pr	Tn3	(CH ₂) ₄ CH ₃	H	H	H
145	Ir	3	Pr	Tn3	H	H		H
146	Ir	3	Pr	Tn3	H	H	H	
147	Ir	3	Pr	Pn1	H	H	H	CF ₃
148	Ir	3	Pr	Np	H	F	H	H
149	Ir	3	Pr	Np	H	H	F	H
150	Ir	3	Pr	Np	F	F	H	H
151	Ir	3	Pr	Np	F	H	F	H
152	Ir	3	Pr	Np	H	F	F	F
153	Ir	3	Pr	Np	H	F	F	H
154	Ir	3	Pr	Np	H	F	H	F
155	Ir	3	Pr	Np	H	H	F	F
156	Ir	3	Pr	Np	F	F	H	H
157	Ir	3	Pr	Np	F	F	F	F
158	Ir	3	Pr	Np	CF ₃	H	H	H
159	Ir	3	Pr	Np	H	CF ₃	H	H
160	Ir	3	Pr	Np	H	H	CF ₃	H
161	Ir	3	Pr	Np	H	H	H	CF ₃
162	Ir	3	Pr	Np	F	CF ₃	H	H
163	Ir	3	Pr	Np	CF ₃	H	CF ₃	H
164	Ir	3	Pr	Np	CF ₃	H	H	CF ₃
165	Ir	3	Pr	Np	H	F	CF ₃	H
166	Ir	3	Pr	Np	H	CF ₃	H	CF ₃
167	Ir	3	Pr	Np	H	H	CF ₃	CF ₃
168	Ir	3	Pr	Np	CF ₃	CF ₃	H	H
169	Ir	3	Pr	Np	H	CF ₃	CF ₃	H
170	Ir	3	Pr	Np	CF ₃	H	F	H

Table 6

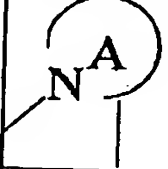
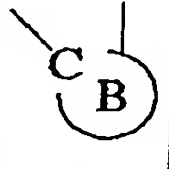
No	M	n			R1	R2	R3	R4
171	Ir	3	Pr	Np	F	H	CF ₃	H
172	Ir	3	Pr	Np	H	H	CF ₃	F
173	Ir	3	Pr	Np	H	H	(CF ₃) ₂ CF ₃	H
174	Ir	3	Pr	Np	H	H	H	(CF ₃) ₂ CF ₃
175	Ir	3	Pr	Np	(CF ₃) ₂ CF ₃	H	H	H
176	Ir	3	Pr	Np	H	(CF ₃) ₂ CF ₃	H	H
177	Ir	3	Pr	Np	(CF ₃) ₂ CF ₃	H	F	H
178	Ir	3	Pr	Np	H	(CF ₃) ₂ CF ₃	H	F
179	Ir	3	Pr	Np	H	H	(CF ₃) ₂ CF ₃	H
180	Ir	3	Pr	Np	H	H	H	(CF ₃) ₂ CF ₃
181	Ir	3	Pr	Np	(CH ₃) ₂ CH ₃	H	H	(CH ₃) ₂ CH ₃
182	Ir	3	Pr	Np	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃	H
183	Ir	3	Pr	Np	H	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃
184	Ir	3	Pr	Np	H	(CH ₃) ₂ CH ₃	(CH ₃) ₂ CH ₃	H
185	Ir	3	Pr	Np	H	(CH ₃) ₂ CH ₃	H	H
186	Ir	3	Pr	Np	(CH ₃) ₂ CH ₃	H	H	H
187	Ir	3	Pr	Np	H	H	(CH ₃) ₂ CH ₃	H
188	Ir	3	Pr	Np	H	H	H	(CH ₃) ₂ CH ₃
189	Ir	3	Pr	Qn1	F	H	H	H
190	Ir	3	Pr	Qn1	H	H	F	H
191	Ir	3	Pr	Qn1	H	F	H	F
192	Ir	3	Pr	Qn1	F	F	F	F
193	Ir	3	Pr	Qn1	CF ₃	H	H	H
194	Ir	3	Pr	Qn1	H	CF ₃	H	H
195	Ir	3	Pr	Qn1	H	H	CF ₃	H
196	Ir	3	Pr	Qn1	H	H	H	CF ₃
197	Ir	3	Pr	Qn1	F	CF ₃	H	H
198	Ir	3	Pr	Qn1	CF ₃	H	CF ₃	H
199	Ir	3	Pr	Qn1	CF ₃	H	H	CF ₃
200	Ir	3	Pr	Qn1	H	H	(CF ₃) ₂ CF ₃	H
201	Ir	3	Pr	Qn1	H	H	H	(CF ₃) ₂ CF ₃
202	Ir	3	Pr	Qn1	(CF ₃) ₂ CF ₃	H	H	H
203	Ir	3	Pr	Qn1	H	(CF ₃) ₂ CF ₃	H	H

Table 7


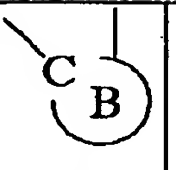
No	M	n			R1	R2	R3	R4
204	Ir	3	Pr	Qn1	H	H	H	(CF ₂) ₂ CF ₃
205	Ir	3	Pr	Qn1	(CH ₂) ₂ CH ₃	H	H	(CH ₂) ₂ CH ₃
206	Ir	3	Pr	Qn1	(CH ₂) ₂ CH ₃	H	(CH ₂) ₂ CH ₃	H
207	Ir	3	Pr	Qn1	H	(CH ₂) ₂ CH ₃	H	(CH ₂) ₂ CH ₃
208	Ir	3	Pr	Qn1	(CH ₂) ₂ CH ₃	H	H	H
209	Ir	3	Pr	Qn1	H	H	(CH ₂) ₂ CH ₃	H
210	Ir	3	Pr	Qn1	H	H	H	(CH ₂) ₂ CH ₃
211	Ir	3	Pr	Qn2	F	H	H	H
212	Ir	3	Pr	Qn2	H	H	F	H
213	Ir	3	Pr	Qn2	H	F	H	F
214	Ir	3	Pr	Qn2	F	F	F	F
215	Ir	3	Pr	Qn2	CF ₃	H	H	H
216	Ir	3	Pr	Qn2	H	CF ₃	H	H
217	Ir	3	Pr	Qn2	H	H	CF ₃	H
218	Ir	3	Pr	Qn2	H	H	H	CF ₃
219	Ir	3	Pr	Qn2	F	CF ₃	H	H
220	Ir	3	Pr	Qn2	CF ₃	H	CF ₃	H
221	Ir	3	Pr	Qn2	CF ₃	H	H	CF ₃
222	Ir	3	Pr	Qn2	H	H	(CF ₂) ₂ CF ₃	H
223	Ir	3	Pr	Qn2	H	H	H	(CF ₂) ₂ CF ₃
224	Ir	3	Pr	Qn2	(CF ₂) ₂ CF ₃	H	H	H
225	Ir	3	Pr	Qn2	H	(CF ₂) ₂ CF ₃	H	H
226	Ir	3	Pr	Qn2	H	H	H	(CF ₂) ₂ CF ₃
227	Ir	3	Pr	Qn2	(CH ₂) ₂ CH ₃	H	H	(CH ₂) ₂ CH ₃
228	Ir	3	Pr	Qn2	(CH ₂) ₂ CH ₃	H	(CH ₂) ₂ CH ₃	H
229	Ir	3	Pr	Qn2	H	(CH ₂) ₂ CH ₃	H	(CH ₂) ₂ CH ₃
230	Ir	3	Pr	Qn2	(CH ₂) ₂ CH ₃	H	H	H
231	Ir	3	Pr	Qn2	H	H	(CH ₂) ₂ CH ₃	H
232	Ir	3	Pr	Qn2	H	H	H	(CH ₂) ₂ CH ₃
233	Ir	3	Pr	Qx	F	H	H	H
234	Ir	3	Pr	Qx	H	H	F	H
235	Ir	3	Pr	Qx	H	F	H	F
236	Ir	3	Pr	Qx	F	F	F	F
237	Ir	3	Pr	Qx	CF ₃	H	H	H

Table 8

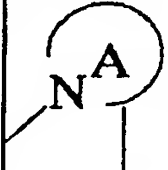
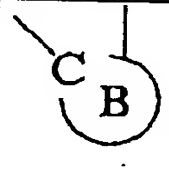
No	M	n			R1	R2	R3	R4
238	Ir	3	Pr	Qx	H	CF ₃	H	H
239	Ir	3	Pr	Qx	H	H	CF ₃	H
240	Ir	3	Pr	Qx	H	H	H	CF ₃
241	Ir	3	Pr	Qx	F	CF ₃	H	H
242	Ir	3	Pr	Qx	CF ₃	H	CF ₃	H
243	Ir	3	Pr	Qx	CF ₃	H	H	CF ₃
244	Ir	3	Pr	Qx	H	H	(CF ₃) ₂ CF ₃	H
245	Ir	3	Pr	Qx	H	H	H	(CF ₃) ₂ CF ₃
246	Ir	3	Pr	Qx	(CF ₃) ₂ CF ₃	H	H	H
247	Ir	3	Pr	Qx	H	(CF ₃) ₂ CF ₃	H	H
248	Ir	3	Pr	Qx	H	H	H	(CF ₃) ₂ CF ₃
249	Ir	3	Pr	Qx	(CH ₃) ₂ CH ₃	H	H	(CH ₃) ₂ CH ₃
250	Ir	3	Pr	Qx	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃	H
251	Ir	3	Pr	Qx	H	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃
252	Ir	3	Pr	Qx	(CH ₃) ₂ CH ₃	H	H	H
253	Ir	3	Pr	Qx	H	H	(CH ₃) ₂ CH ₃	H
254	Ir	3	Pr	Qx	H	H	H	(CH ₃) ₂ CH ₃
255	Ir	3	Pr	Qz1	-	H	F	H
256	Ir	3	Pr	Qz1	-	F	H	H
257	Ir	3	Pr	Qz1	-	F	F	F
258	Ir	3	Pr	Qz1	-	CF ₃	H	H
259	Ir	3	Pr	Qz1	-	H	CF ₃	H
260	Ir	3	Pr	Qz1	-	H	H	CF ₃
261	Ir	3	Pr	Qz1	-	H	(CF ₃) ₂ CF ₃	H
262	Ir	3	Pr	Qz1	-	H	H	(CF ₃) ₂ CF ₃
263	Ir	3	Pr	Qz1	-	H	(CH ₃) ₂ CH ₃	H
264	Ir	3	Pr	Qz1	-	(CH ₃) ₂ CH ₃	H	(CH ₃) ₂ CH ₃
265	Ir	3	Pr	Qz1	-	(CH ₃) ₂ CH ₃	(CH ₃) ₂ CH ₃	H
266	Ir	3	Pr	Qz2	F	-	H	H
267	Ir	3	Pr	Qz2	H	-	F	F
268	Ir	3	Pr	Qz2	H	-	CF ₃	H
269	Ir	3	Pr	Qz2	F	-	H	CF ₃
270	Ir	3	Pr	Qz2	CF ₃	-	(CF ₃) ₂ CF ₃	H
271	Ir	3	Pr	Qz2	CF ₃	-	H	(CF ₃) ₂ CF ₃

Table 9


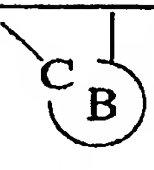
No	M	n			R1	R2	R3	R4
272	Ir	3	Pr	Qz2	(CF ₃) ₂ CF ₂	-	H	(CF ₃) ₂ CF ₂
273	Ir	3	Pr	Qz2	H	-	H	(CH ₃) ₂ CH ₂
274	Ir	3	Pr	Qz2	(CH ₃) ₂ CH ₂	-	(CH ₃) ₂ CH ₂	H
275	Ir	3	Pr	Cn1	-	H	F	H
276	Ir	3	Pr	Cn1	-	F	H	H
277	Ir	3	Pr	Cn1	-	F	F	F
278	Ir	3	Pr	Cn1	-	CF ₃	H	H
279	Ir	3	Pr	Cn1	-	H	CF ₃	H
280	Ir	3	Pr	Cn1	-	H	H	CF ₃
281	Ir	3	Pr	Cn1	-	H	(CF ₃) ₂ CF ₂	H
282	Ir	3	Pr	Cn1	-	H	H	(CF ₃) ₂ CF ₂
283	Ir	3	Pr	Cn1	-	H	(CH ₃) ₂ CH ₂	H
284	Ir	3	Pr	Cn1	-	(CH ₃) ₂ CH ₂	H	(CH ₃) ₂ CH ₂
285	Ir	3	Pr	Cn1	-	(CH ₃) ₂ CH ₂	(CH ₃) ₂ CH ₂	H
286	Ir	3	Pr	Cn2	F	-	H	H
287	Ir	3	Pr	Cn2	H	-	F	F
288	Ir	3	Pr	Cn2	H	-	CF ₃	H
289	Ir	3	Pr	Cn2	F	-	H	CF ₃
290	Ir	3	Pr	Cn2	CF ₃	-	(CF ₃) ₂ CF ₂	H
291	Ir	3	Pr	Cn2	CF ₃	-	H	(CF ₃) ₂ CF ₂
292	Ir	3	Pr	Cn2	(CF ₃) ₂ CF ₂	-	H	(CF ₃) ₂ CF ₂
293	Ir	3	Pr	Cn2	H	-	H	(CH ₃) ₂ CH ₂
294	Ir	3	Pr	Cn2	(CH ₃) ₂ CH ₂	-	(CH ₃) ₂ CH ₂	H
295	Ir	3	Pd	Ph	F	H	H	H
296	Ir	3	Pd	Ph	F	F	F	F
297	Ir	3	Pd	Tn3	H	H	CF ₃	H
298	Ir	3	Pd	Np	F	H	H	CF ₃
299	Ir	3	Pd	Ph	(CF ₃) ₂ CF ₂	H	H	(CF ₃) ₂ CF ₂
300	Ir	3	Pd	Ph	H	(CH ₃) ₂ CH ₂	H	(CH ₃) ₂ CH ₂
301	Ir	3	Py1	Ph	F	H	H	H
302	Ir	3	Py1	Ph	F	F	F	F
303	Ir	3	Py1	Tn3	H	H	CF ₃	H
304	Ir	3	Py1	Np	F	H	H	CF ₃
305	Ir	3	Py1	Ph	(CF ₃) ₂ CF ₂	H	H	(CF ₃) ₂ CF ₂
306	Ir	3	Py1	Ph	H	(CH ₃) ₂ CH ₂	H	(CH ₃) ₂ CH ₂
307	Ir	3	Py2	Ph	F	H	H	H

Table 10

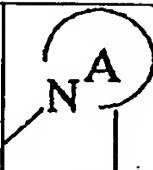
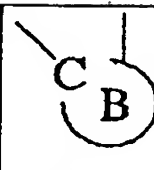
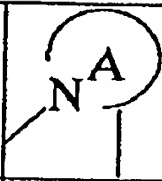
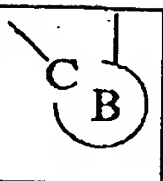
No	M	n			R1	R2	R3	R4
308	Ir	3	Py2	Np	F	F	F	F
309	Ir	3	Py2	Tn3	H	H	CF ₃	H
310	Ir	3	Py2	Ph	F	H	H	CF ₃
311	Ir	3	Py2	Tn3	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
312	Ir	3	Py2	Tn3	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
313	Ir	3	PQ1	Ph	F	H	H	H
314	Ir	3	PQ1	Ph	H	H	F	F
315	Ir	3	PQ1	Ph	F	F	F	F
316	Ir	3	PQ1	Tn3	H	H	CF ₃	H
317	Ir	3	PQ1	Ph	F	H	H	CF ₃
318	Ir	3	PQ1	Tn3	CF ₃	H	(CF ₃),CF ₃	H
319	Ir	3	PQ1	Tn1	CF ₃	H	H	(CF ₃),CF ₃
320	Ir	3	PQ1	Ph	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
321	Ir	3	PQ1	Tn3	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
322	Ir	3	PQ1	Ph	(CH ₃),CH ₃	H	(CH ₃),CH ₃	H
323	Ir	3	PQ1	Ph	H	H	H	(CF ₃),CF ₃
324	Ir	3	PQ1	Ph	(CF ₃),CF ₃	H	H	H
325	Ir	3	PQ1	Np	F	H	H	H
326	Ir	3	PQ1	Np	F	F	F	F
327	Ir	3	PQ1	Np	H	H	CF ₃	H
328	Ir	3	PQ1	Np	F	H	H	CF ₃
329	Ir	3	PQ1	Np	CF ₃	H	H	(CF ₃),CF ₃
330	Ir	3	PQ1	Np	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
331	Ir	3	PQ1	Np	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
332	Ir	3	PQ1	Np	(CH ₃),CH ₃	H	(CH ₃),CH ₃	H
333	Ir	3	PQ1	Np	H	H	H	(CF ₃),CF ₃
334	Ir	3	PQ2	Ph	F	H	H	H
335	Ir	3	PQ2	Np	F	F	F	F
336	Ir	3	PQ2	Tn3	H	H	CF ₃	H
337	Ir	3	PQ2	Ph	F	H	H	CF ₃
338	Ir	3	PQ2	Tn3	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
339	Ir	3	PQ2	Tn3	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
340	Ir	3	PQ3	Ph	F	H	H	H
341	Ir	3	PQ3	Np	F	F	F	F
342	Ir	3	PQ3	Tn3	H	H	CF ₃	H
343	Ir	3	PQ3	Ph	F	H	H	CF ₃

Table 11

No	M	n			R1	R2	R3	R4
344	Ir	3	PQ3	Tn3	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
345	Ir	3	PQ3	Tn3	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
346	Rh	3	Pr	Ph	F	H	H	H
347	Rh	3	Pr	Ph	F	F	F	F
348	Rh	3	Pr	Ph	H	H	CF3	H
349	Rh	3	Pr	Ph	H	CF3	H	H
350	Rh	3	Pr	Ph	F	H	H	CF3
351	Rh	3	Pr	Ph	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
352	Rh	3	Pr	Ph	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
353	Pt	2	Pr	Tn1	F	H	H	H
354	Pt	2	Pr	Tn1	H	H	F	F
355	Pt	2	Pr	Tn1	F	F	F	F
356	Pt	2	Pr	Tn1	H	H	CF3	H
357	Pt	2	Pr	Tn1	F	H	H	CF3
358	Pt	2	Pr	Tn1	CF3	H	(CF ₃),CF ₃	H
359	Pt	2	Pr	Np	CF3	H	H	(CF ₃),CF ₃
360	Pt	2	PQ1	Tn1	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
361	Pt	2	Pr	Tn1	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
362	Pt	2	PQ1	Np	(CH ₃),CH ₃	H	(CH ₃),CH ₃	H
363	Pt	2	Pr	Tn1	H	H	H	(CF ₃),CF ₃
364	Pt	2	Pr	Tn1	(CF ₃),CF ₃	H	H	H
365	Pt	2	Pr	Tn3	F	H	H	H
366	Pt	2	Pr	Tn3	F	F	F	F
367	Pt	2	Pr	Tn3	H	H	CF3	H
368	Pt	2	Pr	Tn3	F	H	H	CF3
369	Pt	2	Pr	Tn3	CF3	H	H	(CF ₃),CF ₃
370	Pt	2	Pr	Tn3	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
371	Pt	2	Pr	Tn3	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
372	Pt	2	Pr	Tn3	(CH ₃),CH ₃	H	(CH ₃),CH ₃	H
373	Pt	2	Pr	Qn1	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃
374	Pd	2	Pr	Tn3	H	H	H	(CF ₃),CF ₃
375	Pd	2	Pr	Ph	F	H	H	H
376	Pd	2	Pr	Ph	F	F	F	F
377	Pd	2	Pr	Tn3	H	H	CF3	H
378	Pd	2	Pr	Np	F	H	H	CF3
379	Pd	2	Pr	Ph	(CF ₃),CF ₃	H	H	(CF ₃),CF ₃
380	Pd	2	Pr	Ph	H	(CH ₃),CH ₃	H	(CH ₃),CH ₃

[Examples]

Hereinafter, the present invention will be described more specifically based on Examples.

<Example 1>

The structure including four organic layers as shown in Figure 1C was prepared as the structure of the device. The opposing electrode area is made into 3 mm^2 by patterning a 100 nm-thick film (transparent substrate 14) of ITO on a glass substrate (transparent substrate 15). On the ITO-formed substrate, three organic layers and two metal electrode layers shown below were successively formed by vacuum (vapor) deposition using resistance heating in a vacuum chamber (10^{-4} Pa).

Organic layer 1 (hole transport layer 13) (40 nm): α -NPD

Organic layer 2 (luminescence layer 12) (30 nm): co-deposited film of CBP: metal complex (metal coordination compound) (8 wt. %)

Organic layer 3 (electron transport layer 16) (30 nm): Alq3

Metal electrode layer 1 (metal electrode 11) (15 nm): Al-Li alloy (Li = 1.8 wt. %)

Metal electrode layer 2 (metal electrode 11) (100 nm): Al

<Example 2>


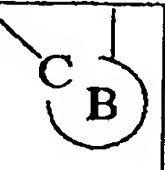
A luminescence device was prepared in the

same manner as in Example 1 except for the metal coordination compound 47 at 7 wt. % in the concentration dispersed in mixture.

<Comparative Example 1>

A luminescence device was prepared in the same manner as in Example 1 except for the metal coordination compound 47R shown in Table 12, at 8 wt. % in the concentration dispersed in mixture.

Table 12

No	M	n			R1	R2	R3	R4
47R	Ir	3	Pr	Tn1	H	H	H	H

<Comparative Example 2>

A luminescence device was prepared in the same manner as in Example 1 except for the metal coordination compound 47R shown in Table 12, at 3 wt. % in the concentration dispersed in mixture.

<Comparative Example 3>

A luminescence device was prepared in the same manner as in Example 1 except for the metal coordination compound 47R shown in Table 12, at 1 wt. % in the concentration dispersed in mixture.

The continuous energization test was performed by continuously applying a voltage at 12.

V/100 nm to the luminescence device having the ITO (transparent) electrode (as an anode) and the Al (metal) electrode (as a cathode), followed by measurement of emission luminance (brightness).

Each of the thus-prepared luminescence devices was taken out of the vacuum chamber and was subjected to a continuous energization (current passage) test in an atmosphere of dry nitrogen gas stream so as to remove device deterioration factors, such as oxygen and moisture (water content).

The measurement results the luminance for the devices using each of the compounds are shown in Table 13. As is apparent from Table 13, the metal coordination compound 47R has the maximum luminance of 1 - 8 %. On the other hand, it is confirmed that luminance of the metal coordination compound 47 having the substituent is increased to 8 %, and that the metal coordination compound 47 exhibits the luminance which is higher than that of the metal coordination compound 47R not having the substituent at 8 % in the concentration.

Table 13

	No.	Density (%)	Luminance (cd/m ²)
Ex. 1	47	8	4500
Ex. 2	47	7	4250
Comp. 1	47R	8	1620
Comp. 2	47R	3	4000
Comp. 3	47R	1	1290

<Example 3>

A simple matrix type organic EL device as shown in Figure 2 was prepared in the following manner.

On a glass substrate 21 measuring 75 mm-length, 75 mm-width and 1.1 mm-thickness, a ca. 100 nm-thick ITO film was formed by sputtering and patterned into 100 lines of 100 μ m-wide transparent electrodes 22 (anode side) with a spacing of 40 μ m as simple matrix electrodes. Then, formed layers of identical organic materials were found under identical conditions as in Example 2 to form an organic compound layer 23.

Then, 100 lines of 100 μ m-wide Al electrodes 24 were formed with a spacing of 40 μ m by mask vacuum deposition so as to be perpendicular to the transparent electrodes 22 by vacuum deposition at a

vacuum of 2.7×10^{-3} Pa (2×10^{-5} Torr). The metal electrodes (cathode) 24 were formed as a lamination of 10 nm-thick layer of Al/Li alloy (Li: 1.3 wt. %) and then 150 nm-thick layer of Al.

The thus-obtained 100x100-simple matrix-type organic EL device was subjected to a simple matrix drive in a glove box filled with nitrogen at voltages of 7 volts to 13 volts by using a scanning signal of 10 volts and data signals of ± 3 volts. As a result of an interlaced drive at a frame efficiency of 30 Hz, respectively, luminescence images could be confirmed. [Advantageous Effect]

As described in foregoing, a luminescence device, comprising: metal coordination compound used in the present invention, having a high phosphorescence quantum yield and a short phosphorescence life, and wherein the optional substituent is introduced into a luminescence material of a metal coordination compound, whereby it is possible to provide a luminescence device less causing a concentration extinction (deactivation) while having a high luminescence efficiency even when a luminescence material as a host material with a phosphorescent material is dispersed into the host material at a higher concentration, and to exhibit the high luminescence efficiency. Further, the luminescence device of the present invention is

superior as a display device.

[Brief Description of the Drawings]

Figures 1A, 1B and 1C are schematic sectional views of an embodiment of a luminescence device according to the present invention, respectively.

Figure 2 illustrates a simple matrix-type organic EL device according to Example 3.

Figure 3 illustrates drive signals used in Example 3.

[Reference Numerals]

- 11: metal electrode
- 12: luminescence layer
- 13: hole transfer layer
- 14: transparent electrode
- 15: transparent substrate
- 16: electron transport layer
- 17: exciton diffusion-prevention layer
- 21: glass substrate
- 22: ITO electrode (transparent electrode)
- 23: organic compound layer
- 24: cathode

FIG. 1

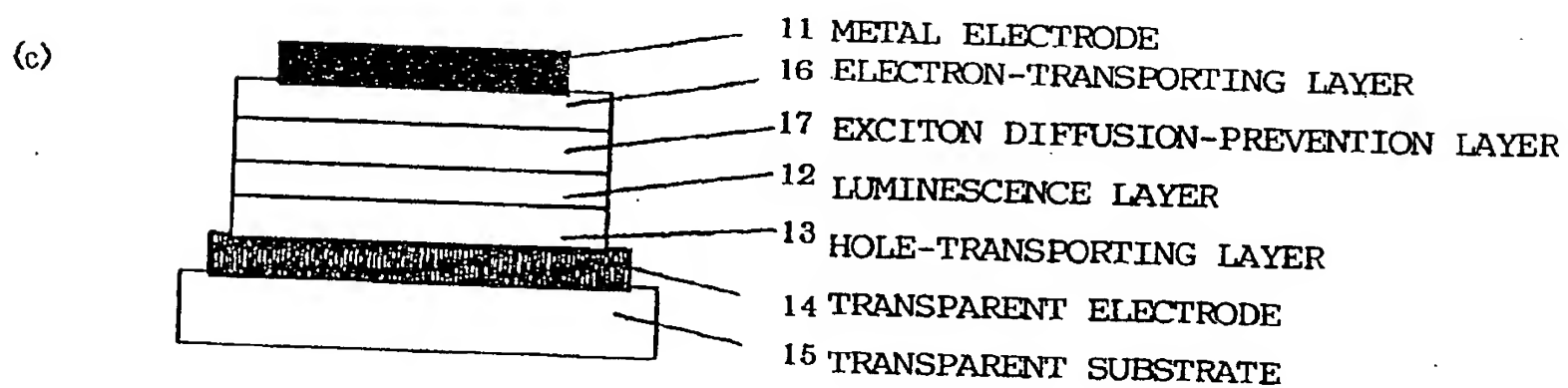
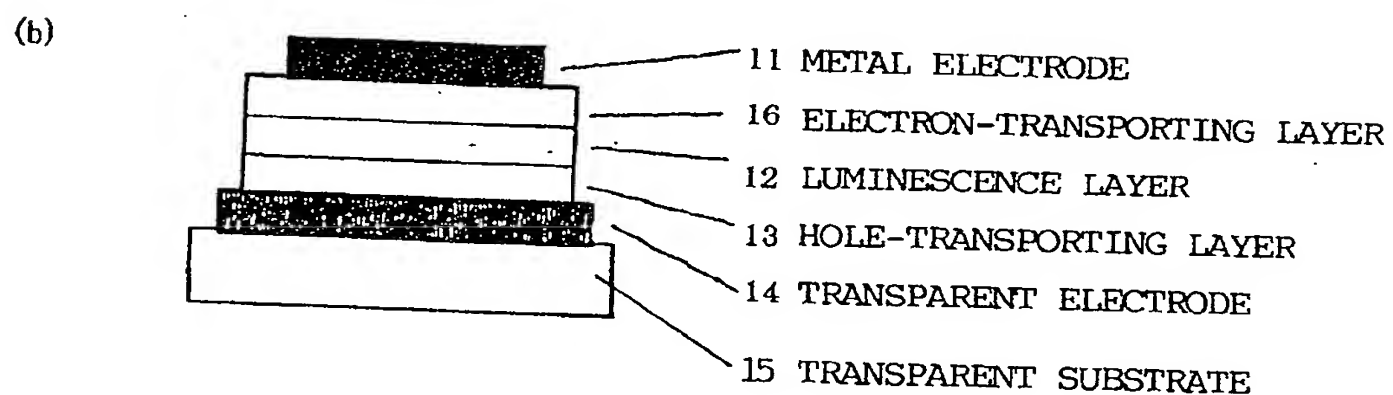
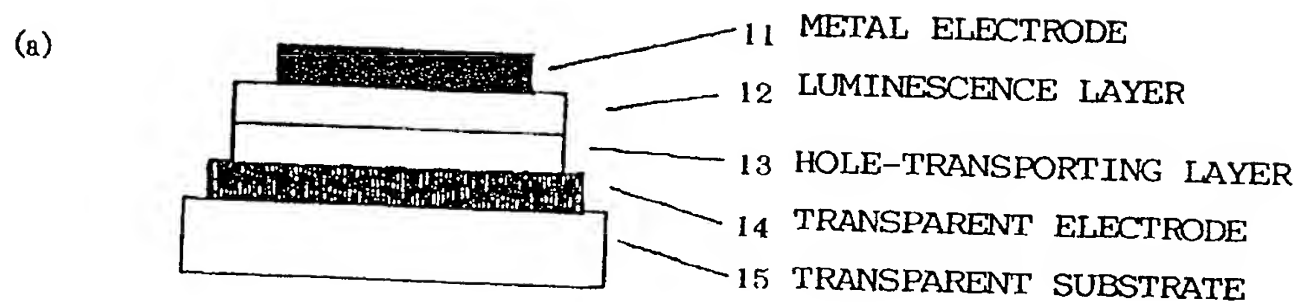


FIG. 2

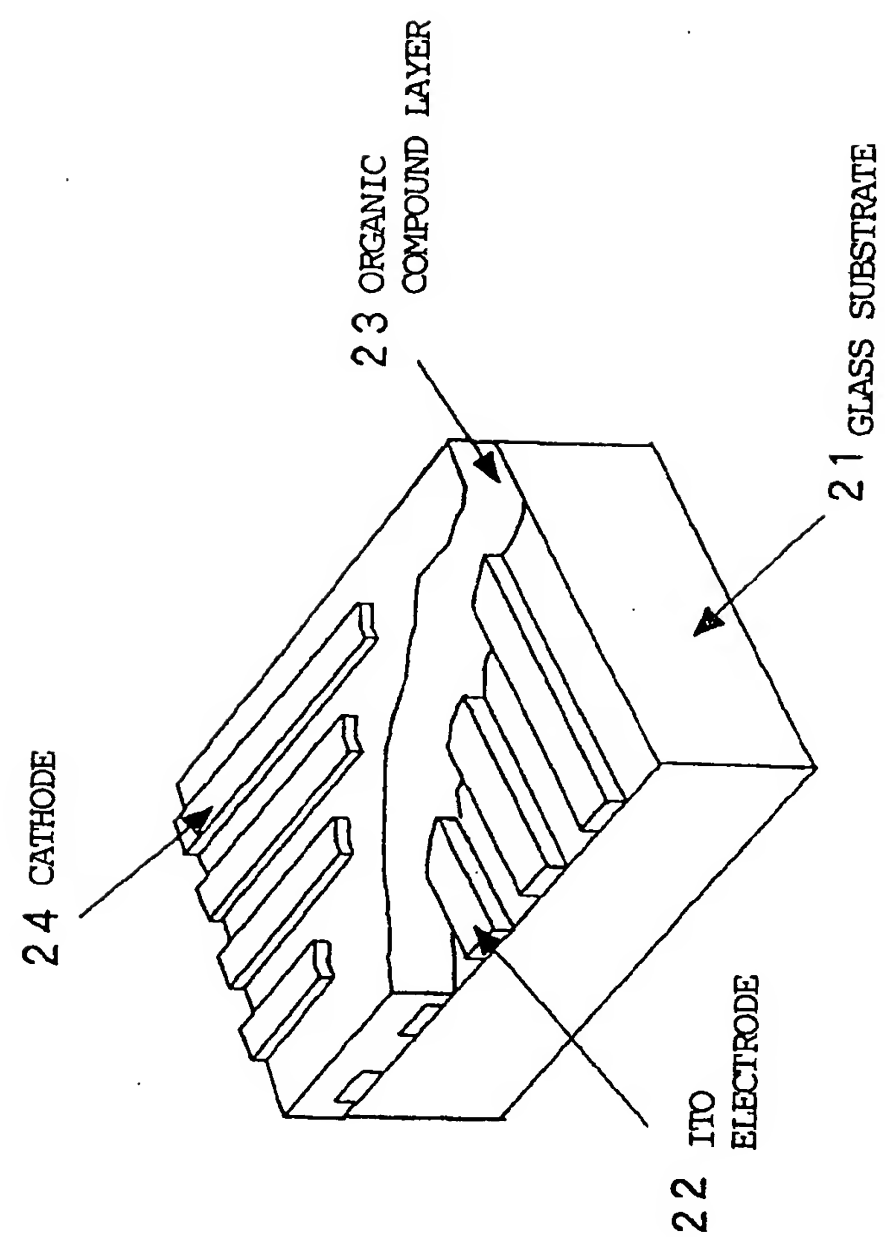
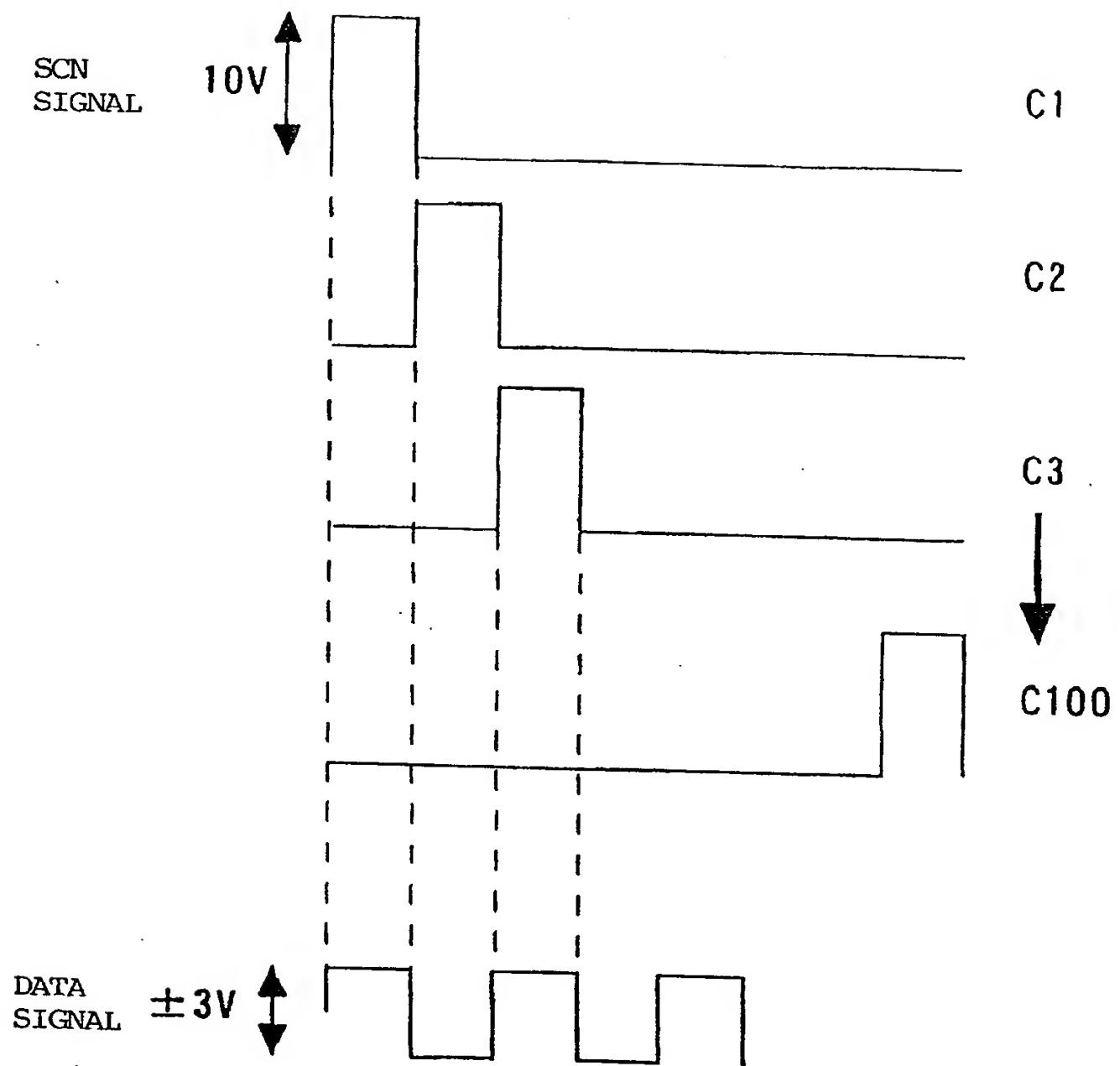


FIG. 3



[Document]

Abstract

[Abstract]

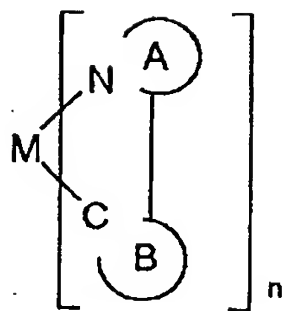
[Object]

It is a principal object of the present invention to provide a luminescence device wherein the optional substituent is introduced into a luminescence material of a metal coordination compound, whereby it is possible to provide a luminescence device less causing a concentration extinction (deactivation) while having a high luminescence efficiency even when a luminescence material as a host material with a phosphorescent material is dispersed into the host material at a higher concentration.

[Means for Solving]

There is provided a luminescence device comprising a single or plurality of organic thin layer between a pair of oppositely disposed electrodes comprising a cathode and an anode; at least one of layers is a luminescence layer; and wherein a luminescence molecule having an optional substituent, which is represented by formula (1) below, is used at a concentration which is larger than a concentration exhibiting a maximum luminescence efficiency in the case that the luminescence molecule having the same structure and not having the optional substituent.

<KA-1>



(1)

[Selected Figure]

Figure 1